Patent Application of J.J. Richardson, Steve Stone and Donald Onken

SENSING DEVICE FOR MONITORING CONDITIONS AT A REMOTE LOCATION AND METHOD THEREFOR

PRIORITY

This is a nonprovisional application of provisional patent application Ser. No. 60/113466, filed December 23, 1998.

INCORPORATION BY REFERENCE

The MICROFICHE APPENDIX that is attached hereto for the software program

submission is incorporated by reference herein. The MICROFICHE APPENDIX includes a page of microfiche containing 35 frames.

FIELD OF THE INVENTION

The present invention is directed to a sensing device for monitoring conditions at a remote location and a method therefor. Particularly, the instant invention is for a sensing device that monitors the conditions of a container at a remote location and a method therefor. More particularly, the disclosed invention is for a sensing device that monitors the level of waste materials in a waste disposal container at a remote location and, then, relays this information to allow for the emptying of the waste disposal container, all without incurring a telephone toll charge.

BACKGROUND OF THE INVENTION

The amount of trash is an ever-growing problem. This is especially true in the retail and commercial sectors, where a large amount of refuse is discarded daily. Most businesses have trash bins adjacent to their buildings for dumping the totality of trash collected either daily or throughout the day. The rate at which the garbage piles up in these trash receptacles varies according to factors such as the season, the industry, the location, etc. Consequently, different businesses and different locations of a business may require different pick-up times for their trash bins.

To minimize the cost of hiring commercial trash collection services to pick-up the trash from the trash receptacles, some companies may designate standard pick-up times, such as daily or weekly, even though the trash bins may not be full. Other companies may call commercial

trash collection services only when their trash bins are full. Either way, the company usually must use the telephone to call the commercial trash collection service. The inevitable result is that a telephone charge is incurred.

The detection of the level of trash in trash receptacles is known in the art. Such detection usually entails some device or method used within the receptacle that senses the level of trash. For instance, a photoelectric cell has been employed for this purpose, as described in U.S. Pat. No. 3,765,147 to Ippolito. Another variation measures the pressure exerted on the trash compactor to detect when the receptacle is full, as disclosed in U.S. Pat. No. 4,773,027 to Neumann. Still, U.S. Pat. No. 3,636,863 to Woyden teaches using pressure-sensing means to determine when the trash container is full.

Additionally, it is known in the art to utilize a means for relaying the information regarding the fullness of the trash receptacle to another location, where the information can be processed. Usually, this relaying method encompasses a telephone or cellular phone line. Some of these devices include U.S. Pat. No. 5,558,013 to Blackstone, Jr.; U.S. Pat. Nos. 5,299,493 and 5,303,642 to Durbin et al.; U.S. Pat. No. 5,214,594 to Tyler et al.; and U.S. Pat. Nos. 5,173,866 and 5,016,197 to Neumann et al.

While each of these systems are useful, they are burdened by several significant disadvantages. First, they fail to teach a way to save the expense of having to pay for telephone toll charges when transmitting information regarding the trash receptacles via a telephone line. This charge may be quite expensive, in light of the fact that some systems maintain a multitude of trash containers. Second, they do not allow users to measure the amount of power supply left in the transmitting means. If the power supply runs out, the waste disposal detection system would be rendered useless. Third, the references do not disclose a way to conserve energy and,

thus, allow one to save on more expenses. And, since these references fail to conserve energy, they are not optimally environmentally friendly. Fourth, the references do not disclose a means to verify that the measurements of the waste disposal container are valid, thereby preventing false readings which may also result in unnecessary charges in emptying a container that is not completely full.

BRIEF SUMMARY OF THE INVENTION

The instant invention is for a sensing device that may be used for detecting various conditions at remote locations. In particular, one embodiment of the invention is directed to a sensing device for detecting the conditions of a container at a remote location. Another embodiment would be used to detect conditions in a waste disposal container at a remote location.

Generally, this invention features three main components: a transmitting module, a receiving module and an identifying means. While each transmitting module is paired with one base module, there may comprise a multitude of such pairings at any one remote location to accommodate the number of containers at that location. Moreover, there may be numerous remote locations comprising such pairings.

The invention also comprises a detecting means for detecting the conditions at the remote location. The detected information is sent to the transmitting module, which has a reading means and a transmitting means. The reading means reads the detected information. In practical usage, the transmitting module also has a first power source for supplying power thereto. The first power source has a power level that is also read by the reading means. The transmitting means sends the information pertaining to the conditions of the remote location and the power level of

the first power source to the base module, which is located near the transmitting module. Advantageously, the transmitting module is only turned-on for approximately 10 seconds, during which time it completes all of its functions. This results in substantial savings in energy charges and is environmentally-friendly.

The base module comprises a receiving means, a first processing means and a conveying means. The receiving means receives the transmitted information from the transmitting module and, then, sends the information to the first processing means of the base module. In one embodiment of the present invention, information from containers located at a close proximity to the base module may be sent directly to the first processing means, without utilizing a transmitting module. Additionally, the base module may have a second power source whereby the power level of this power source is also sent to the first processing means. The first processing means selectively processes all of the information it receives to determine which of a list of pre-programmed telephone numbers to call. In other words, each telephone number matches-up with each of the conditions of the remote location, the amount of power supply in the first and second power sources, and the conditions of the containers located at a close proximity to the base module. The conveying means relays the transmitted information by calling the selected telephone number.

An identifying means is used to identify the remote location of the call. This is typically accomplished by identifying the originating telephone number of the remote location. In the most preferred embodiment, the identifying means does not incur a telephone toll charge. This is accomplished through the use of a second microprocessor having a CALLER ID unit that can identify the location of the originating call without having to "answer" or "connect" the call. Once the originating telephone number of the remote location is identified, one embodiment of

the invention would allow for the container or trash receptacle at the remote location to be emptied or for the power level of the first power source to be recharged.

Another embodiment of the present invention is a method of monitoring the conditions at a remote location. Two other embodiments of the invention include: (1) a method for remotely monitoring the conditions of a container; and (2) a method for remotely monitoring the conditions of a trash receptacle.

It is, therefore, an object of the present invention to teach a means for alleviating the problems associated with the prior art systems of trash receptacle detection.

It is an object of the instant invention to provide a sensing device for monitoring conditions at a remote location and a method therefor.

It is also an object of this invention to provide a sensing device for monitoring the conditions of a container at a remote location and a method therefor.

It is another object of the present invention to provide a sensing device for monitoring the conditions of a waste disposal container and a method therefor.

A further object of this invention is to provide a sensing device that does not incur telephone toll charges and a method therefor.

It is also an object of the instant invention to provide a sensing device that measures the power supply of the transmitting means and a method therefor.

Another object of the present invention is to provide a sensing device that conserves the consumption of energy used by the device and a method therefor.

It is a further object of this invention to provide a sensing device that is environmentally friendly and a method therefor.

It is an object of the present invention to provide a means to verify the information

regarding the conditions of a container.

There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and that will form the subject matter of the invention. Those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other devices for carrying out the several purposes of the present invention. It is important, therefore, that the invention be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present disclosure.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The foregoing and other additional objects of the present invention will be readily appreciated by those skilled in the art upon gaining an understanding of the invention as described in the following detailed description and shown in the accompanying drawings in which:

FIG. 1 is a block diagram illustrating the generalized embodiment of the sensing device of the present invention.

FIG. 2 is a flow diagram showing the steps of the general embodiment of the method of monitoring conditions at a remote location of the present invention.

FIG. 3 is a schematic block diagram displaying another embodiment of the sensing device of the present invention in which the conditions of a container are monitored by the sensing device.

FIG. 4 is a block diagram illustrating one embodiment of the conserving means used in the transmitting module.

FIG. 5 is a flow diagram showing the process of conserving the power level of the first power source in the transmitting module.

FIG. 6A is a flow diagram of one embodiment of the method of monitoring conditions of a waste disposal container at a remote location and matching the conditions to a telephone number.

FIG. 6B is a flow diagram of one embodiment of the method of monitoring conditions of a waste disposal container located at a close proximity to the base module and matching the conditions to a telephone number.

FIG. 6C is a flow diagram of one embodiment of the method of calling the telephone number matched in FIGS. 6A & 6B and conveying information regarding the monitored conditions.

FIG. 7 is a block diagram illustrating one embodiment of the off-hook detecting means used in the base module.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, FIG. 1 shows a block diagram of four sensing devices **10** (not numbered in FIG. 1) of the instant invention. Each sensing device **10** comprises, generally, detecting means **14**, a transmitting module **18**, a base module **22** and identifying means **26**. The detecting means **14** and the transmitting module **18** are located at a remote location **12** (shown as dotted rectangular areas in FIG. 1). The detecting means **14** detects conditions at the remote location **12**. Line **16** shows that the detected information is sent to the transmitting module **18**.

The transmitting module **18** reads the information before transmitting the information, shown by dotted-line **20**, to the base module **22**.

When the base module **22** receives the transmitted information, it processes the information to determine which of a list **136** of pre-programmed telephone numbers to call (shown as step **38** in FIG. 2). This call is shown by line **24**, which also shows the information being conveyed to the identifying means **26**. As FIG. 1 depicts the general embodiment of this invention, other embodiments will be apparent in the following descriptions of the relevant figures. For instance, since the identifying means **26** necessarily identifies the remote location **12** of the call by identifying a telephone number **48**, it follows that each remote location **12** must have its own originating telephone number **48** (not shown). Also, even though only one identifying means **26** is show in FIG. 1, it will be shown *infra* that there most likely comprises a multitude of identifying means **26** to match-up with the host of different conditions processed by the base module **22**.

FIG. 2 is a flow diagram depicting the generalized method for monitoring conditions at a remote location **12**. Step **28** detects the conditions at the remote location **12.** Step **30** reads the detected conditions. Next, the information regarding the detected conditions are transmitted by step **32** and received by step **34**. The information is processed by step **36** to determine which pre-programmed telephone number **135** to call. Step **38** calls the selected pre-programmed telephone number **135**, while step **40** conveys the transmitted information. The remote location **12** of the call is, then, identified by step **42**. In this embodiment, steps **30** and **32** occur in the transmitting module **18**; steps **34** to **40** occur in the base module **22**; and step **42** occurs in the identifying means **26**.

Another embodiment of this invention is shown in FIG. 3, in which a sensing device **10**

(not numbered in FIG. 3) monitors the conditions of a container **44** at a remote location **12**. The container **44** may be any type of container that holds materials, such as liquids or solids. The conditions of the container **44** include whether the container **44** is full or empty, the level of the contents **45** (not shown) in the container **44**, or any other condition that the user needs to monitor. A detecting means **14** is used to analyze the conditions of the container **44**. Detecting means **14** that are compatible with the instant invention include conventional detecting means **14** disclosed in U.S. Pat. Nos. 3,765,147, 4,773,027, and 3,636,863 (cited above). Preferred detecting means **14** include switch inputs **88** and ultrasonic ranging units **130**. The most preferred ultrasonic ranging units **130** comprise units made by Polaroid.

But, the most preferred detecting means **14** are switch inputs **88**. The switch inputs **88** of this embodiment are connected by wires **47**, also called hard wire inputs **132**, to the container **44**. The contents **45** inside of the container **44** are typically oil and grease. A float **49** is placed on top of the contents **45** whereby the float **49** is connected to a first end **47a** of the wires **47**. The second end **47b** of the wires **47** is connected to the switch inputs **88**, which are themselves secured in the transmitting modules **18**. In operation, the float **49** will rise and fall depending on the level of the contents **45** in the container **44**, and this information will be sent to the switch inputs **88**. Each switch input **88** matches with a condition of the container **44**. The preferred embodiment would utilize three switch inputs **88** to indicate whether the container **44** is 3/4 full (input 3 **88c**), 1/2 full (input 2 **88b**) or 1/4 full (input 1 **88a**). If the container **44** is empty, none of the switch inputs **88a-88c** will be activated.

A further embodiment of the present invention illustrated in FIG. 3 is a first power source **50** that provides power to the transmitting module **18**. The first power source **50** has a power level **52** (not shown) that can be measured by a measuring means **62** (not shown) to determine

when it is low and, thus, needs to be recharged or changed. A first power source **50** that may be used with this invention is a battery supply **50**, most preferably a 9-volt battery (not shown).

The information regarding the conditions of the container **44** is sent by the detecting means **14** to the reading means **46** of the transmitting module **18**. The reading means **46** reads both the information from the detecting means **14** and the power level **52** of the first power source **50**, and transfers the information to the transmitting means **54**. The preferred reading means **46** comprises a combination of at least one transistor **56**, at least one resistor **58** and an encoder **60** per switch **88**, when a preferred switch input **88** is used. The transistor **56** conveys high and low switch information to the encoder **60**, and the resistor **58**, along with a capacitor **61**, limits the current to protect the transistor **56** from damage and noise/static. It is preferred that the transistor **56** comprises a 2N3904 transistor **56**. The resistors **58** comprise 10 kilo-ohm resistors **58a**, while the capacitor **61** comprises a 0.1 microferad-50 volt ceramic capacitor **61a**. In another embodiment of the instant invention, a measuring means **62** is used to measure the power level **52** of the first power source **50**. Thereafter, the measuring means **62** also conveys the power level **52** information to the encoder **60**. It is further preferred that the encoder **60** comprise an encoding integrated circuit (IC) **60a**. The most preferred encoder **60** is a Holtek Encoder HT-12E that is commercially available. The measuring means **62** is preferably one half of an operational amplifier (OpAmp) circuit **64**, a plurality of resistors **58** and a voltage reference **65**. The most preferred OpAmp circuit **64** comprises a model LM2903 OpAmp circuit. The preferred resistors **58** used in the measuring means **62** comprise a 10 kilo-ohm resistor **58a**, a 100 kilo-ohm resistor **58c** and a 7.5 kilo-ohm resistor **58d**. The most preferred voltage reference **65** comprises a 2.5 volt voltage reference having model number LM285-2.5.

Still referring to the same embodiment in FIG. 3, a delaying means **66** (not shown) may

be used to delay the encoder **60** from transmitting the data until all the circuitry **110** (not shown) of the encoder **60** is powered up and stable. The delaying means **66** is preferably the other half of the OpAmp circuit **64** described above used in conjunction with a plurality of resistors **58** and a capacitor **61**. The most preferred OpAmp circuit **64** comprises the model LM 2903 OpAmp circuit identified above. The plurality of resistors **58** most preferably comprises two 10 kilo-ohm resistors **58a** and one 100 kilo-ohm resistor **58c**. It is also preferred that the capacitor **61** comprises a 0.1 microferad capacitor **61a**.

Another embodiment of the transmitting module **18** depicted in FIG. 3 is a conserving means **68** that is used to conserve the power level **52** of the first power source **50**. Preferably, the conserving means **68** comprises an activating means **70** that only activates the first power source **50** of the transmitting module **18** at periodic intervals. The most preferred activating means **70** comprises a slow timing circuit **72** that is shown in more detail in FIGS. 4 and 5 and is discussed *infra*.

Still referring to FIG. 3, the transmitting means **54** preferably comprises an encoder **60**, which is most preferably the same encoder **60** used for the reading means **46**. The encoder **60** transmits data over an RF link **256**, shown by line **20**, to the base module **22**. This is accomplished by using an AM transmitting unit **74** or an FM transmitting unit **76**. Preferably, the AM and FM transmitting units **74** and **76** may comprise the AM-RT4-433 unit **74** or the TXM-433-A unit **76**, respectively, both manufactured by Abacom Technologies. Each bit of information transmitted by the transmitting means **54** represents one condition. For instance, information pertaining to the three different levels of the container **44**-- that is, 3/4 full, 1/2 full and 1/4 full-- and the power level **52** of the first power source **50** comprise four conditions which represents 4-bits of information.

Next, the receiving means **78** of the base module **22** receives the transmission from the transmitting means **54**. In particular, the receiving means **78** comprises a receiver **80** and a decoder **82** (both not shown). In operation, the receiver **80** receives the data sent from the transmitting means **54** and conveys the data to the decoder **82**. The receiving means **78** is preferably an RF receiving unit **81** so that it can receive transmissions over the RF link **256**, shown by line **20**. The preferred receiver **80** comprises either an AM receiver **80a** or an FM receiver **80b**, most preferably either the AM-HRR3-433 receiver or the SILRX-433-A receiver, respectively, both manufactured by Abacom Technologies. The decoder **82** is preferably a Holtek decoder **82**, most preferably the HT-12D unit.

Dip switches **176** (not shown) may be used in both the transmitting module **18** and the base module **22** to change the addresses **188**, respectively, of the encoder **60** and the decoder **82**. This allows for multiple pairings of transmitting modules **18** and base modules **22** at the same remote location **12**, shown in FIG. 1, which results in the detection of a number of containers **44** at the same location **12**. The binary address **177** of a transmitting module **18** is matched with the binary address **177** of a base module **22** so that the two modules **18** and **22** may communicate with each other. The most preferred dip switches **176** are four-position dip switches **178** because they allow for sixteen different addresses **177** to exist at a single location **12**. Preferred four-position dip switches **178** are C&K-BD04 dip switches. It is further preferred that the transmitting module **18** and the base module **22** not be farther than 300 feet apart.

The decoder **82**, then, conveys the received data to the first processing means **84**. Preferably, the first processing means **84** comprises a first microprocessor **86**. The most preferred first microprocessor **86** is the Atmel AT89S8252 microprocessor **86**. A rapid timing circuit **346** is used in conjunction with the first microprocessor **86** to constantly activate the first

microprocessor **86**. The rapid timing circuit **346** preferably comprises a rapid oscillator **206a** and two capacitors **61**. The preferred rapid oscillator **206a** comprises a crystal oscillator **206b**, most preferably an 11.0592 mega-hertz xtal oscillator. The preferred capacitors **61** comprise 33 picofarad ceramic capacitors.

It is further preferred that the base module **22** has six switch inputs **88** (discussed *infra*) and transferring means **90** (not shown), whereby the six switch inputs **88a-88f** convey high/opened **91a** and low/closed **91b** switch information to the transferring means **90** which, then, conveys that information to the first microprocessor **86**. As discussed *supra*, three **88a-88c** of the six inputs **88a-88f** may match-up with the level of the contents in a container, while the other three inputs **88d-88f** may match up with other conditions, such as the level of contents in other containers (not shown). If a switch input **88** is in the high/opened state **91a**, then the first microprocessor **86** will not match the condition with a telephone number **135**. But, if a switch input **88** is in the low/closed state **91b**, then this is considered an "active" state **91b** and the first microprocessor **86** matches the appropriate telephone number **135** with the condition to prepare for that number **135** to be dialed (shown in FIG. 6B). The transferring means **90** protects or buffers the external surroundings from the inputs **88** to the first microprocessor **86** to prevent interference therefrom. The preferred transferring means **90** is an inverter **92**, while the most preferred inverter **92** is a trigger inverter **94**. The most preferred trigger inverter **94** is a Schmidt trigger inverter IC **96** having model number 74HC14.

The base module **22** is powered by a second power source **98**. The second power source **98** is preferably a transformer **100**, most preferably a wall transformer **102** having a 12 volt DC output, such as the 12 volt-500ma DC - CUI STACK#DPD120050-P-5 wall transformer. The wall transformer **102** feeds power, sequentially, to a power input jack **104**, a full wave bridge

circuit **106** and a regulator **108**. The regulator **108**, then, feeds power to the rest of the internal circuitry **110** of the base module **22**. The full wave bridge circuit **106** allows any polarity of DC input to power the base module **22** and is, most preferably, a full wave bridge circuit **106** made up of four 1N4004 diodes **107**. The regulator **108** is most preferably a 5-volt regulator **108**, such as the 7805-voltage regulator unit, that converts the incoming 12 volts DC from the wall transformer **100** to a lower power level of 5 volts.

As a precaution against losing the operating program **112** (disclosed in the MICROFICHE APPENDIX attached hereto and discussed *infra*) that is running the first microprocessor **86**, there is a watchdog IC **114** (not shown) that generates a reset pulse **116** to restart and power-up the first microprocessor **86**. To prevent the watchdog IC **114** from generating the reset pulse **116**, it is preferable to utilize a strobe input **118** in the watchdog IC **114** that is periodically strobed or toggled by the first microprocessor **86**. While the strobe input **118** is toggled, the watchdog IC **114** will not generate a reset pulse **116**. But, if the first microprocessor **86** stops toggling the strobe input **118**, the watchdog IC **114** will, after a set time period, generate a reset pulse **116** to restart the first microprocessor **86**. The most preferred watchdog IC **114** is the Maxim MAXCPA1232uP supervisor unit.

Continuing with FIG. 3, the base module **22** preferably has at least one external first-indicator **120** and means **122** (not shown) for turning on the first-indicator **120**. The first-indicator **120** allows human operators (not shown) to supervise the conditions of the base module **22** by connecting the first-indicator **120** to the first processing means **84** of the base module **22**. The means **122** for turning on the first-indicator **120** most preferably comprises at least one transistor output **124**, while the first-indicator **120** comprises at least one lamp **126**. The most preferred lamp **126** is at least one light emitting diode (LED) **174**. In the most preferred

embodiment, the first processing means **84** relays data to the transistor output **124** which lights the lamp **126**, thus alerting operators on the scene of any problems. The preferred transistor outputs **124** comprise MPS-A18 transistors **125**. The first-indicator **120** can be used to alert operators regarding the different conditions of the remote location **12**, the transmitting module **18** or the base module **22**, depending on the preference of the user. The most preferred conditions indicated comprise: the low power level **52** of the second power source **98** of base module **22**; the different levels of the containers **44**; telephone dialing in progress (not shown or numbered); the low power level **52** of the first power source **50** of the transmitting module **18**; and that valid data has been received from the transmitting module **18**.

At least one second-indicator **194** (not shown in FIG. 3) may be used to supplement the first-indicator **120**. The second-indicator **194** is most preferably also an LED **174**. The specific process encompassing this embodiment is discussed *infra* and illustrated in FIG. 6B. In the preferred embodiment, the first-indicator **120** is a lamp **126** that can be seen from a distance to alert operators of potential problems, while the second-indicator **194** is an LED **174** on the base unit **22** that can be viewed at a close range thereto. Additionally, multiple first-indicators **120** and second-indicators **194** may be utilized to indicate different conditions, a sample of which is illustrated in FIG. 6B and its corresponding discussion *infra*. The most preferred LEDs **174** used for the second-indicators **194** comprise size T-1 LEDs **175**. Resistors **58** may be used in series with the LEDs **175** to limit the current running through the LEDs **175**. Preferred resistors **58** comprise 470-ohm resistors **58b**.

The base module may also have reporting means **128** that report conditions at a close proximity to the base module **22**. FIG. 3 illustrates the reporting means **128** reporting the conditions of a container **44** located near the base module **22**. The reporting means **128** operates

in the same manner as the detecting means **14** described above. As such, the reporting means **128** may comprise any of the types of devices discussed for the detecting means **14**. But, the most preferred reporting means **128** are switch inputs **88** (shown in FIG. 3) and ultrasonic ranging units **130**. Either way, the reporting means **128** utilizes wiring **47** to send data from the container **44** to the first processing means **84** of the base module **22**. The preferred wiring **47** is hard wire inputs **132**. If an ultrasonic ranging unit **130** is used as the reporting means **128**, it would use the first microprocessor's **86** internal timing functions **342** to measure the time it takes for an ultrasonic pulse **344** to travel from the top **44a** (not shown) of a container **44** to the contents **45** therein and, then, back to the top **44a** to compute the level of the contents **45** in the container **44**. The most preferred ultrasonic ranging units **130** comprise units made by Polaroid. However, if the switch inputs **88** are used, they would be used in the same manner as described above for the detecting means **14**-- that is, with a float **49** placed on top of the contents **45** within the container **44**. Most preferably, each of the switch inputs **88a-88f** are connected to connectors **154** (not shown) to facilitate external connections to the reporting means **128**. The preferred connectors **154** comprise dual row 12-pin right angle "Molex Microfit" connectors **154b**.

The conveying means **134** of the base module **22** conveys the data processed by the first processing means **84** to the identifying means **26**, as shown by dotted line **24**. It accomplishes this by calling the telephone number **135** determined by the first processing means **84** which matches each condition with an appropriate telephone number **135**, as selected from a list **136** of pre-programmed telephone numbers, identified in FIG. 3 as a pre-programmed telephone number database **136**. The database **136** is ideally stored in non-volatile memory **138** (not shown) inside the first microprocessor **86**. The selection of the appropriate telephone number **135** by the first processing means **84** is accomplished by the novel software program **112** attached to this patent

application, as disclosed in the MICROFICHE APPENDIX. The MICROFICHE APPENDIX and FIGS. 6A-6B also disclose the process by which the appropriate telephone number **135** is selected.

Still referring to the conveying means **134**, it preferably comprises a microprocessor **140**, most preferably the first microprocessor **86** used for the first processing means **84**. The microprocessor **140** has a modem **142** and an operating program **112** (not shown). Modems **142** are commercially available, but the preferred modem **142** is a Cermetec modem having part number 1786LC.

Another component of the conveying means **134** is telephone lines **146** (shown in FIG. 7) used to convey the data. When telephone lines **146** are used, one of skill in the art will know to use telephone jacks **148** (shown in FIG. 7) in the base module **22** for connecting the telephone lines **146** to the base module **22**. The most preferred telephone jacks **148** comprise Corcom RJ11-2L-S telephone jacks **148**. It is to be understood that cellular telephones **150** may be used as a substitute component for telephone lines **146**, in which case modems **142** adapted for use with cellular telephones **150** are required, along with other devices known in the art for utilizing cellular telephones **150**. Thus, line **24** depicts data transmissions by either telephone lines **146** or cellular telephones **150**. FIG. 7 illustrates an off-hook detecting means **348** that detects whether the telephone line **146** is in use (off-hook) or not in use (on-hook) and is described in detail *infra*.

Updating means **152** (not shown) may be used to update the information stored in both the pre-programmed telephone number database **136** and the operating program **112** of the microprocessor **140**. The most preferred updating means **152** is a connector **154**. The preferred connector **154** comprises the 9-pin female D-subminiature right-angle board mount "Amp 745781-4" connector **154a**.

Usually, electrical noise on telephone lines **146** damages the circuitry **156** traveling between the modem **142** and the telephone lines **146**. Protecting means **158** (not shown) are preferably used to protect the circuitry **156**. Preferable protecting means **158** include additional circuitry **160** in the form of high voltage capacitors **162**, ferite beads **164**, resetable fuses **166** and surge protectors **168**. The most preferred ferite beads **164** comprise the "Fair-Rite" 264366611 ferite bead **164a** or the "Fair-Rite" 2943666661 **164b** ferite bead. The most preferred resetable fuses **166** comprise Raychem Polyswitch TR600-150 fuses **170**, while the most preferred surge protectors **168** comprise Teccor Sidactor P3203AB surge protectors **172**. When cellular telephones **150** are used as the conveying means **134**, electrical noise is not a problem, such that protecting means **158** are not required.

Still referring to FIG. 3, the identifying means **26** receives the data sent by the conveying means **132** of the base module **22**. Specifically, a second processing means **180** having a CALLER ID unit **182** is the preferred identifying means **26**. If the second processing means **180** is not used, a CALLER ID unit **182** may be used by itself as the identifying means **26**. Either way, the CALLER ID unit **182** is the component that initially receives the data sent by the conveying means **132**. Preferable CALLER ID units **182** comprise the "WhozzCalling?Lite4"(TM) and "Whozz Calling?Lite8"(TM) units made by Zeus Phonstuff, Inc., Norcross, Georgia, that is commercially available. Furthermore, a printer **184** may be connected to the second processing means **180** so that the data identified by the identifying means **26** may be printed as a written record. The most preferred second processing means **180** is a second microprocessor **190**. It is also preferred that the second microprocessor **190** utilizes a hard drive or a floppy drive (not shown), or most preferably both, to store data comprising information regarding the location **12** of the incoming call.

Once the identifying means **26** identifies the remote location **12** of the originating call to the pre-programmed telephone number **135**, a disconnecting means **186** (not shown) may be used to disconnect the call, thereby not incurring a telephone toll charge. This results in substantial savings for the user. The disconnecting means **186** is most preferably located in the base module **22** and connected to the conveying means **132**. The typical disconnecting means **186** comprises a modem **142**, preferably the same modem **142** used to call the identifying means **26** described above. Further, the disconnecting means **186** optimally allows the telephone call to ring for a time period equivalent to four rings before disconnecting the call, so that the identifying means **180** may identify the remote location **12** of the call. The number of telephone rings may vary depending on one's preference.

Since the conveying means **132** calls different pre-programmed telephone numbers **135** for different conditions, one can determine from observing the identifying means **26** which condition corresponds with which remote location **12**. As a result, one can send, shown by line **200**, either emptying means **196** or recharging/changing means **198**, or both, to the appropriate remote location **12** or to a location at a close proximity to the base module **22** to remedy the problem. It is most preferable that the second processing means **180** comprise software **202** to make the decision shown by line **200**. This software **202** could also be programmed to print out a report detailing the conditions from the transmitting module **18** and/or the base module **22**. Software **202** that is compatible with the second processing means **180** comprises the "Callwhere(R) Plus for Windows" program made by A&A TeleData, Austin, Texas, that is commercially available.

Emptying means **196** may involve using a human operator (not shown) to physically empty the container **44** or it may involve contacting a commercial service (not shown) to empty

the container **44**. Recharging means **198** include either recharging or changing the first **50** or second **98** power source.

Referring now to FIG. 4, the conserving means **68** of the transmitting module **18** is shown in a block diagram. The specific embodiment displayed is a slow timing circuit **72** (indicated by a dotted rectangular area) that only activates the transmitting module **18** at periodic intervals. The slow timing circuit **72** comprises a counter **204** having an oscillator **206** and an RC time constant **208**. The oscillator **206** preferably comprises a slow oscillator **206c**. The RC time constant **208** controls the frequency **210** (not shown) of the slow oscillator **206c**, as shown by line **212**. The counter **204** triggers a one-shot circuit **214** within the slow timing circuit **72** when a pre-selected count **216** is reached, shown by line **218**. The one-shot circuit **214** is only activated for 10 seconds so as to conserve energy. Thereafter, the one-shot circuit **214** turns on the first power source **50** of the transmitting module **18**, depicted by line **220**. The activated one-shot circuit **214** also resets the counter **204** back to its starting count **216**, illustrated by line **222**. The most preferred counter **204** is a CD4060BCN counter **204a**, while the most preferred one-shot circuit **214** is a CD4538BCN one-shot circuit **214a**.

FIG. 5 shows a flow diagram of the process of conserving the power level **52** of the first power source **50**. A starting count **224** is initially set at zero. Then, step **226** shows that the counter **204** starts the count. Step **228** decides whether the pre-selected count **216** has been reached. The most preferred pre-selected count **216** set to five hours, but one of skill in the art will know that the pre-selected count **216** is variable depending on one's preferences and needs. If the pre-selected count **216** has not been reached, then the count continues, as shown by line **229a**. But, if the pre-selected count **216** is reached, line **229b** shows that the next step **230** is to trigger the one-shot circuit **214** for 10 seconds. Once the one-shot circuit **214** is triggered, step

232 activates the first power source **50** of the transmitting module **18** and step **234** resets the counter **204** back to the starting count to start the process again, all within the 10 seconds of activation. In the manner described above, the power level **52** of the first power source **50** is not continually used; rather, the first power source **50** is only activated at periodic intervals for merely 10 seconds to run the transmitting module **18**. The transmitting module **18** uses the most power when it is transmitting data during this short time period. Otherwise, the conserving means **68** causes the transmitting module **18** to "sleep" and not consume the power level **52** of the first power source **50**. This results in large monetary savings for the user and is also environmentally friendly.

FIG. 6 is split into three flow diagrams which, in totality, illustrate one preferred embodiment of the instant invention in which: FIG. 6A illustrates the process of monitoring the conditions of a waste disposal container **236** at a remote location **12**; FIG. 6B shows the process of monitoring the conditions of a waste disposal container **236** at a close proximity to the base module **22**; and FIG. 6C illustrates the process of conveying the conditions monitored by FIGS. 6A and 6B so that appropriate steps are taken to remedy the conditions. Both FIG. 6A and FIG. 6B emphasize the steps of matching the monitored conditions with one of the telephone numbers **135** selected from the list of pre-programmed telephone numbers **136**.

Referring firstly to FIG. 6A, step **238** detects the conditions of the waste disposal container **236** at the remote location **12**. Step **240** measures the power level **52** of the first power source **50**. Step **241** activates the transmitting module **18** using the conserving means **68**. Step **242** reads the information obtained during steps **238** and **240**. Next, the information is encoded by step **244**. Transmission of the information is delayed by step **246** until all circuitry **110** is powered up and stable. Step **248** decides whether all of the circuitry **110** is powered up and

stable. If not, line **250** shows that the transmission must be delayed by step **246** until the answer to step **248** is in the affirmative. But, if the answer to step **248** is yes, then line **252** indicates that the information is transmitted by step **254**, which shows the process of transmitting the information over the preferred RF link **256** (not shown). After the information is transmitted by step **254**, dotted-line **257a** shows that the transmitting module **18** goes to sleep as step **257**. Dotted-line **257b** illustrates that the transmitting module **18** sleeps until it is activated again by step **241**.

The transmitted information is received by step **258** and decoded by step **260**. Step **262** shows that the information must be firstly verified, because an initial transmission by the transmitting step **254** may contain a false reading of the level of the contents **45** in the waste disposal container **236**. To prevent the processing of false readings, a second transmission received by the receiving step **258** must contain the same information as the initial transmission for the information to be considered valid. The initial and second transmission-- called consecutive transmissions-- must necessarily occur at five-hour intervals in the preferred emobdiment, because the transmitting module **18** is only activated by the activating step **241** every five hours. For example, if, during the initial transmission, the contents **45** in the waste disposal container **236** did not settle, any readings of such information would be inaccurate. Thus, during the second transmission, if the contents **45** have settled, then a different reading would be taken, and the information received from consecutive transmissions of step **254** would not be the same and, hence, would not be firstly verified by step **262**. Consequently, only two consecutive transmissions having the same readings would comprise valid information.

Additionally, to further ensure that the information transmitted by step **254** is valid, receiving step **258** disables the base unit **22** for twenty seconds after it receives information from

the transmitting module **18**. As a result, no information, whether containing false readings or not, may be received by step **258** during this twenty-second period.

Continuing with FIG. 6A, step **264** decides whether the transmitting step **254** sent two consecutive transmissions. If not, then line **266** shows that the receiving step **258** is revisited to determine whether more transmissions are forthcoming from step **254**. If the transmitting step **254** does send two consecutive transmissions, at five-hour intervals, then line **268** leads to a series of steps which match a condition at the remote location **12** with a telephone number **135** from the list **136** of pre-programmed telephone numbers.

Step **270** decides whether the remote waste disposal container **236** is 3/4 full or more. If so, then line **271a** leads to step **300** which matches ("matching step") that condition with a telephone number **135**. It is important to note that the matching steps **300** disclosed in FIGS. 6A-6C are all typically conducted by the novel software program **112** disclosed in the MICROFICHE APPENDIX attached hereto. If the answer to step **270** is in the negative, line **271b** leads to step **272** to determine whether the remote waste disposal container **236** is 1/2 full or more. If so, then line **273a** leads to the matching step **300** to match that condition with a telephone number **135**. If the answer to step **272** is in the negative, then line **273b** leads to step **274** to decide whether the remote container **236** is 1/4 full or more. If so, then line **275a** leads to the matching step **300**. If not, then line **275b** leads to step **276**.

Step **276** determines whether the remote trash container **236** just made a transition from being either 1/2 or 3/4 full, or more, to being empty. If so, line **277a** leads to the matching step **300**. If not, line **277b** leads to step **278**, which determines whether the power level **52** of the first power source **50** is low. If the power level **52** is low, line **279a** leads to the matching step **300**. But if the power level is not low, line **279b** leads to step **280** to determine whether the

transmitting module **18** is responding properly. If the transmitting module **18** is not responding properly, line **281a** leads to the matching step **300**. However, if the transmitting module **18** is responding properly, then line **281b** indicates that receiving step **258** is revisited to prepare to receive another transmission from the transmitting module **18**. Incidentally, the order of steps **270-280** is not of paramount importance. One skilled in the art will know that these steps may be arranged in any order to suit one's preference.

Monitoring the transition of the remote trash container **236** from being 1/2 or 3/4 full, or more, to being empty via step **276** is important because experience shows that some remote trash containers **236**, and other types of containers **44**, may have their contents **45** stolen. It is favorable, then, for the activating step **241** to be "awakened" immediately in such circumstances so that this information may be transmitted by step **254**. The quicker activation of step **241** may be adjusted depending on the user's preference. Thus, once this transition is detected and received by step **258**, then step **300** matches the appropriate telephone number **135** with this condition, thereby allowing the steps illustrated in FIG. 6C (discussed below) to convey this transition. The desired result is to catch potential thieves in the act, or shortly thereafter.

Referring now to FIG. 6B, step **282** reports the conditions of any waste disposal containers **236** in close proximity to the base module **22**, and step **284** reports the power level **52** of the second power source **98**. Step **286** decides whether the power level **52** of the second power source **98** is low. If the second power source **98** is at low power, line **287a** will lead to step **300** to match this condition with a telephone number **135** from the list **136** of pre-programmed telephone numbers. Step **300** is the same as the match step **300** disclosed in FIG. 6A, so it will als be termed the "matching step" **300**. If, however, the power level **52** of the second power source **98** is not low, then line **287b** will lead to step **284** to continue reporting the

power level **52**. Steps **284-286** are preferably utilized when the second power source **98** is a battery, since batteries tend to be used up sooner than the power from a transformer **100** (disclosed above).

The information reported by step **282** must be secondly verified by step **288**. Step **288** is similar to step **262** (shown in FIG. 6A and its accompanying discussion) in that the former ensures that no false readings are reported by step **282**. However, since step **282** is not subject to the five-hour interval transmissions of step **254** (shown in FIG. 6A), another verifying technique must be utilized. As such, the secondly verifying step **288** is accomplished by the preferred switch inputs **88** staying in the same high/opened or low/closed state for three seconds to allow the contents **45** of the waste disposal container **236** to stabilize or to allow for any electrical noise to be ignored before the information is considered valid. Step **290** determines whether the information reported by step **282** is constant for three seconds. If not, line **291a** returns to step **288** to attempt to verify the reported information. If so, line **291b** shows that the reported information is considered valid.

Still referring to FIG. 6B, step **292** determines whether the waste disposal container **236** located at a close proximity to the base module **22** is 3/4 full or more. If so, line **293a** leads to step **294** to light a green **174a**, yellow **174b** and red **174c** light emitting diode ("LED"). The LEDs **174a-174c** disclosed in FIG. 6B provide operators stationed at or near the base module **22** with notice of the level of the trash container **236** located near the base module **22**. Line **295** indicates that once the LEDs **174a-174c** are lit, the condition is matched with a telephone number **135** by the matching step **300.** If the answer to step **292** is in the negative, line **293b** leads to step **296** to determine whether the waste disposal container **236** is 1/2 full or more. If so, line **297a** leads to step **298** to light the green **174a** and yellow **174b** LED. Then, line **299** leads to the

matching step **300**. But if the container **236** is not 1/2 full or more, line **279b** leads to step **302** to decide whether the trash container **236** is 1/4 full or more. If so, line **303a** leads to step **304** to light the green LED **174a**. Thereafter, line **305** leads to the matching step **300**. If the answer to step **302** is in the negative, then line **303b** leads to step **306** to determine whether the waste disposal container **236** has undergone the transition from 1/2 or 3/4 full, or more, to empty (as discussed above). If this transition is detected, line **307a** leads to matching step **300**. However, if the answer to the transition step **306** is in the negative, line **307b** leads back to step **282** to restart the reporting process for the waste disposal container **236** at close proximity to the base module **22**. One of skill in the art will know that the color of the LEDs **174a-174c** in the above-described embodiment may be varied according to one's desires and tastes. These descriptions are merely a sample of one of the preferred embodiments of the disclosed invention.

Referring to FIG. 6C, matching step **300** is shown to indicate the position where FIGS. 6A-6B leave off and where FIG. 6C begins. After telephone number **135** is matched with the appropriate condition by step **300**, step **308** sends the information comprising the matching telephone number **135** to step **310**, which detects whether the telephone line **146** is on-hook (not in use) or off-hook (in use), discussed *infra* and shown in more detail in a block diagram in FIG. 7. Step **312** is the decision step that determines whether the telephone line **146** is on- or off-hook. If the telephone line **146** is off-hook, the answer to step **312** is in the negative and line **313a** indicates that step **310** is revisited to repeat the off-hook detection. But, if step **312** determines that the telephone line **146** is on-hook, the answer to step **312** is positive and line **313b** shows that the process proceeds to step **314** to call the matched telephone number **135**. Once the telephone number **135** is called, step **316** conveys the information by way of having an originating telephone number **48** that step **318** identifies. Once the originating telephone number

48 has been identified, step **320** disconnects the call. Step **320** most preferably disconnects the call after the fourth ring, or another set time period. This prevents a telephone toll charge from being incurred, since the call is not answered. Thereafter, either one of steps **322** or **324** may take place depending on whether the waste disposal container **236** needs to be emptied (step **322**) or one of the first **50** or second **98** power sources needs to be recharged or changed (step **324**).

Additionally, it should be noted that after the call is disconnect by step **320**, the base module **22** prepares to receive information from the transmitting module **18** (step **258** in FIG. 6A) and to report the conditions of the trash container **236** located close to the base module **22** (step **282** in FIG. 6B) and the power level **52** of the second power source **98** (step **284** in FIG. 6B).

When the telephone line **146** of the base module **22** is not in use (on-hook), the modem **142** of the conveying means **134** will successfully be able to call the selected telephone number **135**. But, if the telephone line **146** is already being used, or off-hook, the modem **142** will not be able to make a call on that line **146**. The problem of not knowing whether the telephone line **146** is on-hook or off-hook is solved by an off-hook detecting means **348** that is illustrated in a block diagram in FIG. 7. Referring to FIG. 7, the off-hook detecting means **348** (not shown in FIG. 7) detects when the telephone line **146** is in use and sends the off-hook information to the first microprocessor **86**, which does not allow the modem **142** to call the selected telephone number **135**. Likewise, the off-hook detecting means **348** also detects when the telephone line **146** is on-hook and, thereby, sends this information to the first microprocessor **86** to allow the modem **142** to make the call.

The preferred off-hook detecting means **348** comprises a plurality of diodes **350** connected to the telephone lines **146** leading, at one end (not numbered), to a telephone jack **148**

and, at another end (not numbered), to a plurality of discrete circuits **352**. The discrete circuits **352** lead to an opto-isolator IC (opto-coupler IC) **354** that provides the first microprocessor **86** with the on-hook and off-hook information. In a preferred embodiment of the off-hook detecting means **348** as shown in FIG. 7, the preferred diodes **350** comprise four diodes **350a-350d** in a full wave bridge configuration **356**. The diodes **350a-350d** generate positive (+) and negative (-) voltage changes, whereby a positive voltage change represents that the telephone line **146** is on-hook and a negative voltage change represents that the telephone line **146** is off-hook. The preferred discrete circuits **352** comprise a first discrete circuit **352a** and a second discrete circuit **352b**, whereby the first discrete circuit **352a** detects the positive or negative voltage change from the diodes **350a-350d** and relays that information to the second discrete circuit **352b**. The second discrete circuit **352b**, then, becomes activated and further relays the on-hook/off-hook information to the opto-isolator IC **354**. The opto-isolator IC **354** preferably comprises an LED **174** and a phototransistor **358**. The LED **174** is lit when the telephone line **146** is off-hook and dim when on-hook. Once the information passes through the LED **174**, it is sent to the phototransistor **358** that is light-activated and relays the information from the LED **174** to the first microprocessor **86**. The first microprocessor **86** will, therefore, be informed as to whether the telephone line **146** is on- or off-hook.

This invention has great utility in the waste disposal industry, but it may also be useful in other industries where remote containers or locations need to be monitored. Hence, while the invention has been described in connection with a preferred embodiment, it will be understood that it is not intended that the invention be limited to that embodiment. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as disclosed.

As to the manner of usage and operation of the instant invention, same should be apparent from the above disclosure, and accordingly no further discussion relevant to the manner of usage and operation of the instant invention shall be provided.

With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

Therefore, the foregoing is considered illustrative of only the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.